MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 3, 2015/2016

POC0335 – ORGANIC CHEMISTRY

(Foundation in Life Sciences students only)

2 JUNE 2016
2.30 p.m. – 4.30 p.m.

(2 Hours)

INSTRUCTIONS TO STUDENT

1. This question paper consists of **7** pages only excluding the cover page.
2. Answer **ONE** out of **TWO** questions in **Section A**, and **ALL** questions in **Section B**.
3. Please write all your answers in the answer booklet provided.
4. Distribution of marks for each question is given.

SECTION A [20 MARKS]

Instructions: Answer **ONE** out of **TWO** questions.

Question 1 [20 marks]

a. Some data for the first six members of the alkane family are given in the table below.

Alkane	Molecular formula	Molar mass ($g\ mol^{-1}$)	Melting point (°C)	Boiling point (°C)
Methane	CH_4	16	−182	−164
Ethane	C_2H_6	30	−183	−88
Propane	C_3H_8	44	−188	−42
n-Butane	C_4H_{10}	58	−138	−0.5
n-Pentane	C_5H_{12}	72	−130	36
n-Hexane	C_6H_{14}	86	−95	69
n-Heptane	C_7H_{16}	90	−90	98

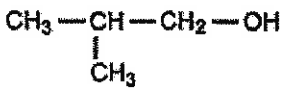
(i) Name the alkanes that have their molecules distributed randomly at great distances apart under room conditions. [2 marks]

(ii) How do the boiling points of the alkanes change with their molar mass? Explain your answer. [3 marks]

(iii) Petrol obtained from fractional distribution of petroleum contains an alkane which is immediately after n-heptane. Give the name and molecular formula of this alkane. [2 × ½ mark]

(iv) Combustion of 1 mole of heptane releases more heat than the combustion of 1 mole of hexane. Give your reason. [2 marks]

b. An organic molecule has the following structure.



(i) Name the homologous series which this molecule belongs to and give its general formula. [2 × ½ mark]

(ii) Draw the structure of the product formed when this molecule is oxidized by hot acidified potassium dichromate(VI). [1 mark]

(iii) Draw the structure of the product formed when this molecule is dehydrated by hot concentrated sulphuric acid. [1 mark]

(iv) Write an equation (balanced) for the reaction between this molecule with sodium to liberate hydrogen gas and form metal alkoxide. [2 marks]

(v) How will this product of dehydration react with a solution of bromine in tetrachloromethane? Write a balanced equation for the reaction which takes place. [3 marks]

c. Draw and name two non-alkenes with the molecular formula, C_4H_8. [2 × 2 marks]

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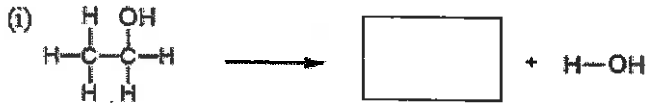
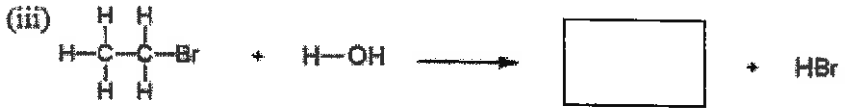
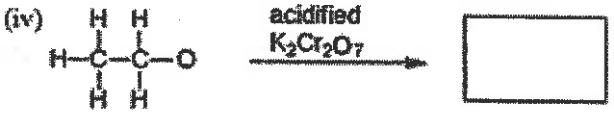
Question 2 [20 marks]

a. Name the type of reaction and draw the structure of the product formed in each of the following reactions. [4 × 2 marks]

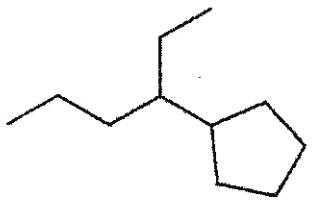
(i) 

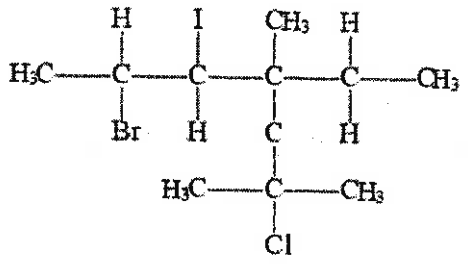
(ii)

(iii) 

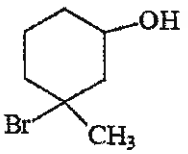
(iv) 

b. Give the IUPAC name for the following compounds. [4 × 2 marks]

(i) 

(ii) 

(iii)

(iv) 

c. Functional group isomers have the same molecular formula but different functional groups. They also have different chemical and physical properties. Draw 2 functional group isomers with the molecular formula, $C_4H_8O_2$. [2 × 2 marks]

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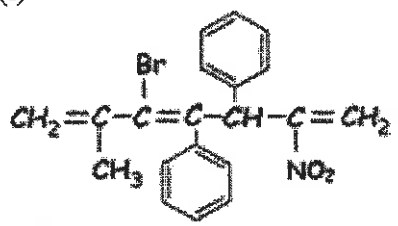
SECTION B [80 MARKS]

Instructions: Answer **ALL** questions.

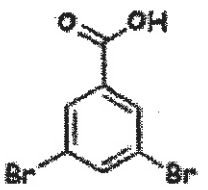
Question 1 [20 marks]

a. Give the IUPAC name for the following compounds. [2 × 2 marks]

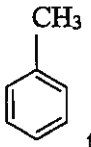
(i)



(ii)



b. Predict the major product formed (draw the structure) if toluene undergoes the following series of reactions. [2 × 2 marks]

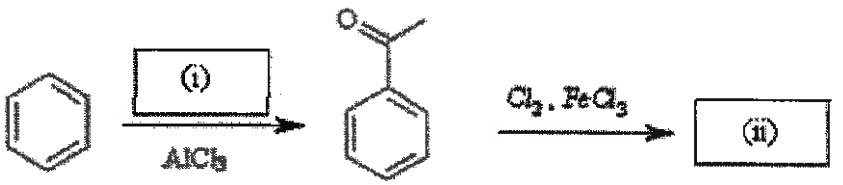


toluene

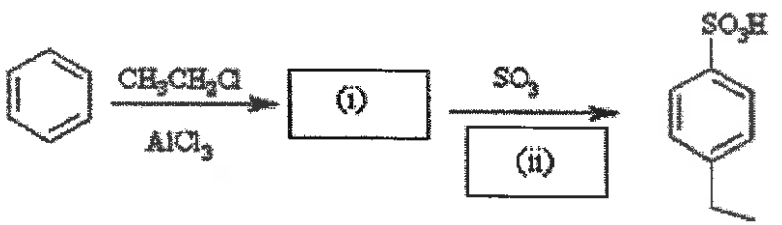
(i) $\xrightarrow[H_2SO_4]{HNO_3}$ $\xrightarrow{H_2CrO_4}$

(ii) $\xrightarrow{H_2CrO4}$ $\xrightarrow[H_2SO_4]{HNO_3}$

c. Complete the following reaction and name each step of the reaction. [2 × 3 marks]



d. Complete the following reaction and name each step of the reaction. [2 × 3 marks]



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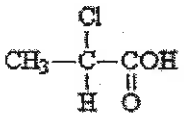
Question 2 [20 marks]

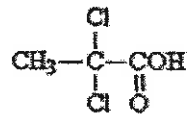
a. Write a structural formula for each of the following: [4 × 2 marks]

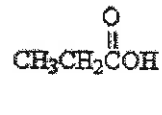
(i) 2,3,4,5-tetrahydroxyhexanal
(ii) 10-fluorodecanal
(iii) 2-phenylethanal
(iv) 2,3-pentanedione

b. Arrange the compounds below in the order of increasing acidity (lowest first). [2 marks]


I

II

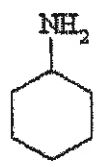

III

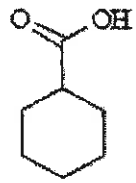

IV

c. Arrange the compounds below in the order of increasing boiling point (lowest first). [2 marks]

I

II


III

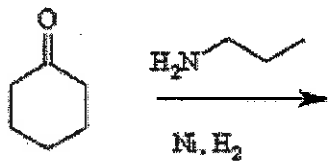

IV

d. Draw a structural formula for the product formed by treating butanal with each of the following set(s) of reagents: [2 × 2 marks]

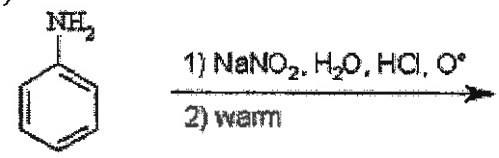
(i) H_2/Pt
(ii) H_2CrO_4

e. Complete the following reaction. [2 × 2 marks]

(i)



(ii)



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Question 3 [20 marks]

a. Vinegar is sour because it contains an organic acid.

(i) Give the name and formula of the organic acid found in vinegar. [2 × ½ mark]

(ii) What is observed if a piece of marble is dropped into vinegar? [1 mark]

(iii) Write an equation (balanced) for the reaction that occurs in (ii). [2 marks]

(iv) Give the name and formula of the alcohol which can be converted into this acid. [2 × ½ mark]

(v) Name the process that converts alcohol to this acid. [1 mark]

(vi) Name the chemical used for this conversion. [1 mark]

(vii) Draw the structure of the product formed when this acid is reacted with $(CH_3)_2CHCH_2OH$ under the catalytic action of a little concentrated sulphuric acid. [1 mark]

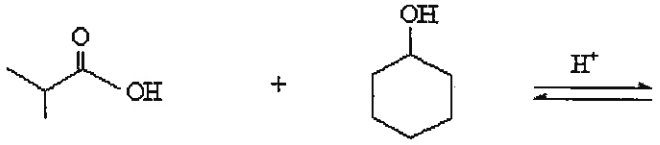
(viii) What class of organic compound is formed in (vii) and give one physical property of it. [2 × ½ mark]

b. Name the general formula of the carboxylic acid derivatives below. [3 × 1 mark]

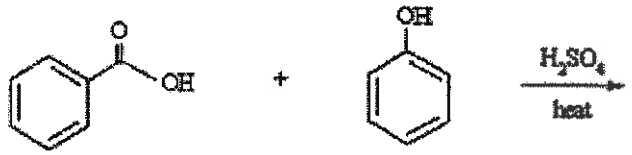
(i) $RCCl$ (ii) $RCNH_2$ (iii) $RCOCR'$

c. Complete the following reactions: [2 × 2 marks]

(i)

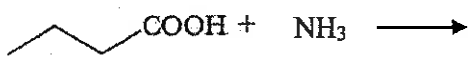


(ii)



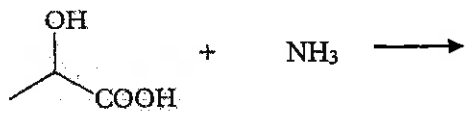
d. Complete each acid-base reaction below and name the salt that is formed in the reaction. [2 × 2 marks]

(i)



Butanoic acid

(ii)



2-hydroxypropanoic acid

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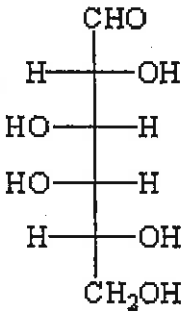
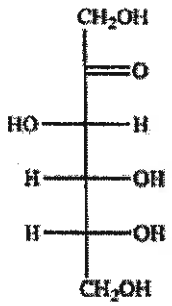
Question 4 [20 marks]

a. The Fischer projection of D-galactose is shown below. Galactose exists as a mixture of α – D – galactose and β – D – galactose.
(i) What is a D-monosaccharide? [2 marks]
(ii) Draw the Haworth projections for the α and β molecules of D-galactose. [2 × 2 marks]

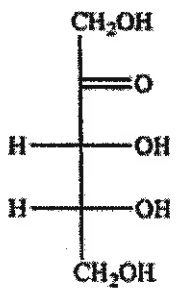


D-galactose

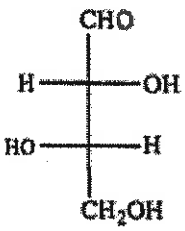
b. The figures below show four Fischer projections of carbohydrate, A, B, C and D. Classify each of these carbohydrates based on the number of carbons and the functional group. [4 × 1 mark]



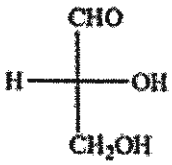
A



B

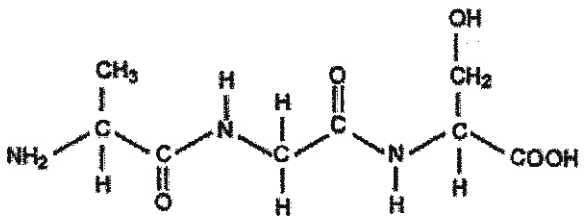


C



D

c. Peptide bonds can be broken to yield amino acids through the process of hydrolysis. Draw the structures of all the amino acids formed when the polypeptide below is hydrolysed. [3 × 1 mark]



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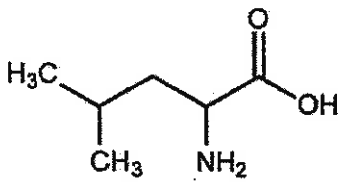
d. For the following mixtures of amino acids, predict the direction of each component during electrophoresis. (Isoelectric point: valine = 5.96; glutamic acid = 3.22; phenylalanine = 5.48; serine = 5.68)
(i) Valine and glutamic acid at pH = 7.6 [2 × 1 mark]
(ii) Phenylalanine and serine at pH = 5.5 [2 × 1 mark]

e. The figure below shows the structure of leucine. Leucine is an amino acid.
(i) Draw the zwitterion structure for leucine. [1 mark]
(ii) Write the structure of the products formed when leucine reacts with NaOH. [2 marks]



Leucine

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